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DEPARTMENT OF AGRICULTURE

Eighth Annual Report of the Coffee Research and Experiment Station, Lyamungu, Moshi 1941

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COFFEE RESEARCH AND EXPERIMENT STATION, LYAMUNGU, MOSHI

Report for the period 1st January to 31st December 1941

ADMINISTRATION

Staff List in January 1941

Chief Scientific Officer in general charge.—S. M. Gilbert, B.Sc., N.D.A., Dip. Agric. (Wye).

Plant Pathologist.—G. B. Wallace, B.Sc., Ph.D. (Edin).

Staff Changes

The other pre-war posts were either unfilled or the occupants were on war service.

The Plant Pathologist was absent on leave from the 25th April to the 30th August 1941. During this period the services of Mr. H. Marsland, Agricultural Officer, were available for general duties.

Contacts with Growers

Owing to the absence of many planters on service and to limitation of travel due to shortage of staff visits to growers were less frequent than was desirable. On the other hand visits of African coffee growers to the station increased considerably.

Finance

Details of expenditure for the year are given in Appendix I.

Revenue amounted to £280, plus £10 12s.—the value of beans used in labourers' rations.

Miscellaneous

Substantial assistance was given by the loan of valuable reference books, apparatus, chemicals and reagents to institutions engaged on more direct war work including the East African War Supplies Laboratory, the East African Agricultural Research Station, Scott Agricultural Laboratories and the Government Laboratory, Dar es Salaam.

Station Development

The planting of Experiment VI—a factorial investigation into the nitrogen requirements of *Coffea arabica*—was completed with clonal material. The following table reflects concisely the position at the end of the year.

How occupied	Acres	Change
Coffee :—		
(a) under three years	31	− 7
(b) over three years	46	+10
Nurseries	2	− 2
Bananas and fodder grasses	36	+10
Paddocks	30	+10
Coppices and wind belts	27	+ 1
In preparation for experiments	5	−27
Forest	30	
Roads, buildings, etc.	27	
Bush—uncleared	68	+25
Food gardens for labourers	8	−20
Total ...	310	

Over seven tons of parchment coffee were produced.

Meteorology

The total rainfall was 56·67 inches (1,439·4 millimetres). October was dry but heavy rain fell in November and December. The short rains were the heaviest since the station began (nearly fifteen inches). The year was almost ideal for the vegetative growth of coffee but equally so for pest development and the damage to the crop particularly from Antestia was serious in spite of routine control measures. Leaf miner was, however, relatively scarce.

Vegetative Propagation

The switch over from the propagation of ordinary material for precise field experiments to that of potential (and a few actual) selections proceeded satisfactorily. Some five thousand rooted cuttings of selected trees were obtained. Sufficient plants of each of several trees are available for planting out a formal comparative trial on the station in the long rains of 1942.

Selection Work

In the main, field records of mother trees were completed for the year. Laboratory studies, however, are behind-hand. The seedling progeny of one selection shows great promise by its vigorous growth in the field.

Cultural and Manurial Investigations

On estates and native holdings.—Crop yields were recorded on most of the co-operative experiments described in the 1940 report. Owing to overbearing in that year the crop failed in 1941 on several estates. In another case the area was "stumped" to bring the coffee on to "multiple stem". A new experiment was begun at the request of a planter to investigate the value of mulching.

Estate B.—Summary of Results—1941

Mean yield	Nil	Sulphate of ammonia (a)	Compost (b)	Half each of (a)&(b)	Mean	Standard error	Sig. dif. P=·01
Clean cwt. per acre...	3·7	5·8	3·5	4·6	4·4	·07	·54
Percentage	84·1	131·1	79·5	104·5	100·0	1·6	12·3

Yearly mean yield—1936 to 1941 (six years)

							P = ·05
Clean cwt. per acre...	5·73	7·07	6·19	6·81	6·45	0·21	0·74
Percentage	88·8	109·6	96·0	105·6	100·0	3·3	11·5

It is seen from the above tables that sulphate of ammonia has been consistently successful and has led to an increased profit. The compost applied in 1941 was poor (being incompletely broken down) and no result was to be expected.

Estate F.—Summary of Results—1941

Mean yield	Nil	Sulphate of ammonia	Pen manure	Mulch	Mean	Standard error	Sig. dif.
Clean cwt. per acre...	1·85	2·16	1·95	1·88	1·96	·08	—
Percentage	94·4	110·2	99·5	95·9	100·0	4·1	—

Yearly mean yield—1936 to 1941 (six years)

							P = ·2
Clean cwt. per acre...	2·8	3·8	3·6	3·5	3·5	·07	—
Percentage	80·0	108·6	102·9	100·0	100·0	2·0	—

The results for 1941 are low following a heavy crop in 1940. Over a period of six years all treatments have given an average increase over untreated plots of more than twenty per cent.

Estate L.—Summary of Results—1941

Mean yield	Nil	Sulphate of ammonia	Pen manure	Banana mulch	Mean	Standard error	Sig. dif.
Clean cwt. per acre...	3·84	3·98	3·92	4·19	3·98	·50	—
Percentage	96·5	100·0	98·5	105·3	100·0	12·6	—

Yearly mean yield—1936 to 1941 (six years)

							*
Clean cwt. per acre...	3·12	3·82	3·35	3·56	3·46	·30	—
Percentage	90·2	110·4	96·8	102·9	100·0	8·7	—

No treatments were applied in 1941; records were, however, obtained to see what residual value, if any, was left from previous applications. There appears to be none. Over a period of six years there has been little response to treatments on the estate although nitrogen seems to be having some beneficial effect.

Estate E.—The crop failed in 1941. The year 1940 was an "on" year.

On Kilimanjaro none of the large-scale manurial experiments have survived. On Estate AJ although no treatments were applied yield records were obtained and the table below indicates some residual value from previous applications.

Estate AJ.—Summary of Results—1941

Mean yield	Nil	Sulphate of ammonia (a)	Pen manure (b)	Half each of (a)&(b)	Mean	Standard error	Sig. dif. P=·2
Clean cwt. per acre...	7·92	8·74	8·67	9·02	8·59	1·28	—
Percentage	92·20	101·75	100·93	105·01	100·00	14·90	—

On Meru the crop failed on Estate AN due to overbearing. Plots receiving sulphate of ammonia looked better and a larger percentage survived "dieback". The experiment on AR was allowed to bear a maximum crop before going over to multiple stem. The other two estates, AP and AQ, gave substantial increases of yield where nitrogen was applied. The results are summarized overleaf.

*Does not pass Z test.

Estate AP.—Summary of Results—1941

Mean yield	Nil	Sulphate of ammonia (a)	Pen manure (b)	Half each of (a)&(b)	Mean	Standard error	Sig. dif.
							P = ·01
Clean cwt. per acre...	4·28	5·50	4·86	5·60	5·06	·24	1·62
Percentage	84·6	108·7	96·0	110·7	100·0	4·74	32·02

Estate AQ.

							P = ·01
Clean cwt. per acre...	1·74	2·65	1·95	2·46	2·20	·15	·59
Percentage	79·1	120·5	88·6	111·8	100·0	6·8	26·9

Estate AR.

							P = ·2
Clean cwt. per acre...	8·89	8·58	7·37	9·43	8·57	·55	1·07
Percentage	103·7	100·1	80·0	110·0	100·0	6·42	12·49

Experiments on Station

General.—Throughout the station the economic and agronomic values of mulch were confirmed. Yield responses paid for the cost. Timed weedings were carried out on all new experiments embodying the use of mulch. These showed that banana trash, at six weedings a year, saved Shs. 15/- per acre in cutlassing; weeding was not necessary. Guinea grass proved next best in this respect but elephant grass was not very effective. The latter, however, showed promise of very considerable manurial value. Sulphate of ammonia again enabled trees to bring to maturity a crop which would otherwise have turned to "buni". The importance of the availability of irrigation water was amply demonstrated on coffee, banana and fodder grasses owing to the bad distribution of rainfall in 1940. The experience of several planters, and this station, seems to indicate the need for some kind of co-operative control of pests and diseases. For example with the most careful routine measures of control Antestia did enormous damage to crop this year on the station. The value of the new experiments is, at present, considerably reduced owing to the impossibility of carrying out studies of development and of soil changes because of the absence of staff essential to such work.

Experiment I.—Method of Planting—Planted 1935

(a) MAIN PLOTS

	Mean yield 1941		Mean of 4 years	
	Clean cwt. per acre	Percentage	Clean cwt. per acre	Percentage
No holing	11·94	103·0	7·07	101·1
*H3F1	11·67	100·7	7·59	108·6
†HF1	10·76	92·8	6·41	91·7
Hole sub-soiled :				
Without compost, H3F1	12·30	106·1	7·47	106·9
,, ,, HF1	11·43	98·6	6·77	96·9
Hole not sub-soiled :				
With compost, H3F1 ...	11·72	101·1	7·34	105·0
,, ,, HF1 ...	11·32	97·7	6·36	91·0
Mean	11·58	100·0	6·99	100·0
Standard error	0·41	3·5	0·20	2·90
Significant difference, P=·2	— ‡	—	0·37	5·30

*H3F1=Holed three months and filled one month before planting. †HF1=Holed and refilled one month before planting. ‡Does not pass Z test.

(b) SUB-PLOTS

	Mean yield 1941		Mean of 4 years	
	Clean cwt. per acre	Percentage	Clean cwt. per acre	Percentage
Planting :				
Deep with ball of earth ...	11·20	96·8	6·41	91·7
Deep bare roots	10·54	91·0	6·36	91·1
At nursery level—				
With ball of earth ...	12·03	103·9	7·58	108·4
Bare roots	12·56	108·5	7·65	109·4
Mean	11·58	100·0	6·99	100·0
Standard error	0·21	1·82	·13	1·83
Significant difference, P=·01	0·69	6·0	·48	6·80

Although in 1941 alone "no holing" did better than before, the results over a period of years clearly show that the opening up of holes well in advance of planting, refilling in good time to allow the soil to settle and planting at nursery level, give an adequate return for the trouble taken. Sub-soiling and compost had no appreciable effect.

Experiment II.—Seedling Selection Trials.—Planted 1938 to 1939.

This area is making good progress and recording will begin in 1942.

Experiment III.—Clonal and Seedling Trees.—Planted 1937

A complete failure is recorded in the efforts to graft scions on to "single" stem trees. Success is being obtained with grafting on to suckers on "multiple" stem trees and all the original material had to be converted for this purpose. The experiment should be sufficiently uniform to record in 1943.

Experiment IV.—Seedling Stocks.—Planted 1936

To date this area has demonstrated that certain types and varieties of coffee are useless as stocks for arabica. Robusta is the chief of these. The grafting of promising material cannot be done with the present staff.

Experiment V.—Mulch, Compost and Nitrogen

The coffee in this trial made excellent growth and, although planted out only in 1940, will have a "fly" crop in 1942.

Experiment VI.—Effects of Nitrogen

The experiment was planted in the long rains and an even stand resulted. The shade trees *Albizzia maranguensis*, *Albizzia stipulata* and *Maesopsis eminii* were given similar preparation to the coffee and the work has been easily justified by the response in growth. No treatments have as yet been applied. The fertilizers failed to arrive.

Experiment VII A.—Conversion to Multiple Stem—Converted 1940

	Mean yield 1940		1941	
	Clean cwt. per acre	Percentage	Clean cwt. per acre	Percentage
Clean stump, 3 suckers ...	0·7	31·8	10·2	105·2
Cut off west side primaries, 3 suckers from bottom ...	2·9	131·8	8·1	83·5
Cut off east side primaries, 3 suckers from bottom ...	2·9	131·8	9·7	100·0
Cut off all except top 3 primaries, 3 suckers from bottom	3·9	177·3	10·5	108·3
Agobiada, multiple stem, 3 suckers	1·2	54·5	11·4	117·5
Top cut at 3 feet from ground and 3 suckers left to grow at top	2·0	90·9	7·8	80·4
Mean	2·2	100·0	9·7	100·0
Significant difference, P=·01	0·76	34·5	1·97	20·2

It will be seen that over two years the plots, converted to multiple stem by cutting off all except the top three pairs of primaries, have maintained their superiority.

An interesting point in connection with this experiment is the value of an application of a quarter of a pound of sulphate of ammonia given during the long rains of 1941. At the end of a long dry period ending before the long rains the trees showed signs of overbearing. The alternatives were to reduce crop or to apply fertilizer. The latter course was adopted; the table shows the results and the trees are in splendid condition.

Experiment IX.—Methods of Cultivation.—Planted 1934

	Mean yield 1941		Mean of 4 years 1938-41	
	Clean cwt. per acre	Percentage	Clean cwt. per acre	Percentage
Treatment :				
Forked hoe (forked jembe)	9·23	106·6	4·06	98·8
West Indian hoe (jembe)	8·23	95·0	4·48	109·0
Nil	9·16	105·8	4·07	99·0
Envelope forked	7·32	84·5	3·82	92·9
Trenched	9·33	107·7	4·14	100·7
Mean	8·66	100·0	4·11	100·0
Standard error	0·33	3·67	0·85	20·7
Significant difference*	—	—	—	—

Over a period of four years the various kinds of cultivation have failed to be reflected in the yields.

Experiment X.—Artificial Shade.—Planted 1937

SUMMARY OF RESULTS—1941

	Mean yield	
	Clean cwt. per acre	Percentage
Canopies of webbing one inch width and one inch spacing, sixteen feet from ground	2·13	108·7
Canopies of webbing one inch width and two inches spacing, sixteen feet from ground	2·11	107·7
Nil	1·41	71·9
Ground shade of Terrolas and sand plaster	2·23	113·8
Mean	1·96	100·0
Standard error	0·13	6·1
Significant difference, P=·05	0·49	25·0

All forms of shade have benefited yields but the most interesting point is the value of ground shade, which confirms experience on citrus and cocoa in Trinidad. Unfortunately the experiment has to be suspended as webbing is no longer obtainable.

Experiment XI.—Kents versus *Bourbon.—Planted 1935*

SUMMARY OF RESULTS—1938 TO 1941

	Clean cwt. per acre	
	Kents	Bourbon
1938	7·69	7·12
1939	4·86	3·11
1940	3·70	5·10
1941	12·87	9·51
Mean	7·28	6·21

No comments are necessary.

*The results are not significant.

Experiment XII.—Selection in Nursery.—Planted 1935

	Mean yield 1941		Mean of 4 years 1938-41	
	Clean cwt. per acre	Percentage	Clean cwt. per acre	Percentage
Tops cut back	5·83	84·5	3·53	87·2
Good roots and good tops ...	8·67	111·2	4·86	120·0
Average	7·23	104·8	4·10	101·2
Good tops and poor roots ...	7·00	101·4	4·41	108·9
Poor tops and good roots ...	6·07	88·0	3·73	92·1
Poor tops and poor roots ...	6·60	95·7	3·67	90·6
Mean	6·90	100·0	4·05	100·0
Standard error	0·87	12·6	0·38	9·4
Significant difference P=·2	— *	—	0·72	17·8

The indications are that the selection of the best seedlings in the nursery reflects itself in the yield of the trees over the period of four years.

Experiment XIII.—Type of Growth.—Planted 1936

The following table shows that coffee grown on multiple stem (three suckers from stumps) has in this year heavily outyielded both single stem and multiple stem obtained by bending over the original stem (agobiada). No real deduction can be drawn until a complete cycle of growth—about seven years—has been finished.

SUMMARY OF RESULTS 1941

	Mean yield	
	Clean cwt. per acre	Percentage
Single stem	7·42	84·5
Multiple stem, 3 suckers	12·40	141·2
Multiple stem, 3 suckers agobiada ...	6·52	74·3
Mean	8·78	100·0
Standard error	0·10	1·13
Significant difference, P=·05 ...	0·33	3·76

Experiment XIV.—Mulch Experiment.—Planted 1935

	Mean yield 1941		Mean of 4 years 1938-41	
	Clean cwt. per acre	Percentage	Clean cwt. per acre	Percentage
(a) Banana mulch (100 lb. per tree) ...	9·74	133·2	6·43	139·8
(b) Guinea grass mulch (100lb.)	8·73	119·4	5·56	120·9
(c) †Banana mulch (50lb.) plus S. of A. (½lb.)	9·43	129·0	4·81	104·6
(d) †Elephant grass mulch (100lb.) ...	9·31	127·4	4·12	89·6
(e) Clean weeded	4·81	65·8	3·79	82·4
(f) Weeds as mulch	4·67	63·9	3·72	80·9
(g) †Elephant grass mulch (50lb.) plus S. of A. (½lb.)	6·75	92·3	4·07	88·5
(h) Compost (50lb.) per tree	5·61	76·7	4·23	92·0
Mean	7·31	100·0	4·60	100·0
Standard error	0·86	11·8	0·25	5·4
Significant difference, P=·01 ...	3·32	45·4	0·96	20·9

The above experiment has given useful results. Banana trash maintained its place as best with guinea grass second. There are indications that elephant grass is rapidly improving the old cover crop plots. For the second year in succession compost gave a significant increase on the clean weeded plots.

Experiment XV.—Irrigation and Banana Mulch

This coffee, planted in 1940, is an outstanding ocular demonstration, firstly of the value of irrigation in times of drought and, secondly, of the use of mulch in conserving moisture and reducing weed growth. The coffee in the best plots, those having banana mulch and receiving irrigation in dry months, are three times the size of those in the untreated plots. A small crop has set on the larger trees.

*Does not pass Z test.

†Note that these plots had two years of very harmful cover crop treatments.

Stock

The health of the stock was very good. No trypanosomiasis occurred in the herd until 24th December when two heifers which had just calved reacted. They had reacted a year before. However, a bull loaned to natives a few miles away succumbed. Thirteen calves were born of which only three were heifers. This was to be expected if the opinion of practical stock-keepers is accepted. A very young bull was in use. Several home bred heifers calved for the first time and their milking performance was encouraging on native standards, reaching as they did nearly one hundred gallons in the first four months of their lactations. It was clear, however, that no real "grading up" could be achieved without the introduction of a bull of known good pedigree. Such a beast was accordingly purchased with the kind assistance of the Kenya Veterinary Department. It is a black native Baraton bull of the 250—300 gallon class. Sixteen of the herd are known to be in calf to him. A demand developed for bulls from cows of known milk performance. Rotational grazing in fenced paddocks continued. Additional rations were on the scale given in the last report.

At the end of the year the stock consisted of :—

Kind	Number
Stud bull	1
Cows and in-calf heifers	16
Heifers due to breed	2
Heifer calves	5
Oxen and young bulls	11
Bull calves	10
Donkey	1
Total	46

Fodder Grasses

The area under *Pennisetum purpureum* (elephant grass) was extended. The main area was used roughly as follows :—

(a) the June cuttings for mulch;

(b) the September to November, dry season, cuttings for compost;

(c) December to March cuttings for fodder.

The "time of cutting" experiment yielded the following results :—

Elephant Grass.—Time of Cutting.—Planted 1938

SUMMARY OF RESULTS 1940 TO 1941

	Yield	
	Tons per acre per annum	Percentage
10 weeks	62·9	116·3
12 ,,	52·5	98·9
14 ,,	60·4	111·4
16 ,,	66·1	122·2
18 ,,	55·6	102·9
20 ,,	63·6	117·6
Mean	54·1	100·0
Standard error	6·38	11·18
*Significant difference	—	—

Too much should not be read, however, into these figures because over a year only one good fall of rain might unduly influence the yields of one set of plots if it happened immediately after cutting. Rather are the figures an indication of what four-year-old elephant grass will yield in a year.

*Not significant

Paddocks

Further areas were cleared and fenced. The second species of Pennisetum mentioned in last year's report was identified by the Botanist at Amani as *Pennisetum salifex*. It is expected that enclosed paddocks will considerably lessen the risk of loss of cattle from insect-borne diseases such as trypanosomiasis and east coast fever.

Bananas

The area under this crop was enlarged by four acres and the total area should now be sufficient for the mulching programme envisaged.

Lyamungu,
January 1942

S. M. Gilbert,
Chief Scientific Officer

Appendix I

STATEMENT OF EXPENDITURE FOR THE PERIOD 1st JANUARY TO 31st DECEMBER 1941

I.—Personal Emoluments

Item No.	Provision Shs.	Cts.		Expenditure Shs.	Cts.
3. Chief Scientific Officer				24,000	00
17. Asiatic Clerk				3,100	00
18. Recorders				5,493	48
19. Mechanic				2,086	13
20. African Mechanics	40,880	00		451	77
23. African Laboratory Assistants ...				1,200	00
24. Overseers, Agricultural Stations ...				546	67
25. Motor Drivers				532	00
26. Messengers				195	00
	40,880	00	...	37,605	05

II.—Other Charges

29. Upkeep of Agricultural Stations ...	1,070	00		759	10
34. Upkeep of Coffee Research Station :					
(a) Labour				15,000	00
(b) Field Experiments of Station ...				1,483	52
(c) Maintenance of Power, Gas, Water, etc.	25,400	00		1,858	28
(d) Upkeep of Coffee Factory ...				995	12
(e) Upkeep of Stock				987	94
(f) Equipment and Materials ...				4,021	13
Carried forward ...	26,470	00	...	25,105	09

Item No.		Provision Shs.	Cts.		Expenditure Shs.	Cts.
	Brought forward ...	26,470	00	...	25,105	09
36.	Plant Sanitation	120	00	...	109	38
39.	Books of Reference	900	00	...	122	43
40.	Travelling Allowances	600	00	...	364	26
41.	Transport Allowances	1,800	00	...	1,380	68
42.	Transport	1,000	00	...	803	18
43.	Railway Fares and Freight	800	00	...	594	79
47.	Maintenance and Running of Motor Vehicles	2,500	00	...	2,450	62
48.	Stationery	500	00	...	195	90
53.	Contingencies	300	00	...	152	69
		34,990	00	...	31,279	02
	Outstanding accounts on Crown Agents Indents	...	...	...	1,423	00
		34,990	00	...	32,702	02

Appendix II

REPORT OF PLANT PATHOLOGIST

I was away from the Territory, on special leave, from 25th April to 30th August; during that period the work of the laboratory was supervised by Mr. H. Marsland, Agricultural Officer.

Routine spraying was carried out on experimental plots at Uru and Arusha, the former in February, the latter in March, June and October.

Under present circumstances mycological work and travelling have been reduced to a minimum. Advisory work in Plant Pathology and Entomology have been maintained.

Mycological Circular No. 6 on "Banana stem and root disease", *Marasmius stenophyllus*, was issued. A collection of banana varieties of Kilimanjaro is being made for a study of their relative susceptibility to that disease.

A disease of tea roots, caused by a species of Rosellinia, was observed in a few trees for the first time in this Territory.

Lyamungu,
January 1942

G. B. WALLACE,
Plant Pathologist